3D Plan Modeling from a Program Perspective

Presenters

- Eric Arneson, P.E.
  - WisDOT, Methods Development
- Chris Goss
  - Hoffman Construction Company
- Roberta Oldenburg
  - Mortenson Construction

Topics

- CIM at WisDOT (past, present, and future)
- WisDOT model oriented design workflow
- Implementing Roadway Surface Model Deliverable
- Expanded use of CIM at Wisconsin DOT on Mega-Projects

History of CIM at WisDOT

- Digital alignments and profiles have been part of data exchange package since 2001
- Certain roadbuilder firms have reverse engineered 3D models for years on projects
- 3D roadway models identified as goal in 3D implementation plan in 2006
- Statewide specification for use of AMG operations developed in 2008
- Model sharing pilot 2011

WisDOT current perspective on CIM

- Use of information models in transportation benefits the Department, Roadbuilders, and travelling public
- Roadway models that are ready for AMG operations should be a design deliverable on all projects that would have cross sections in a 2D plan set
- CIM activities beyond AMG surfaces should be considered on large corridors and mega-projects

WisDOT Model Oriented Design Workflow

- AMG for grading spec development in 07 – 08
  - Contractors' message – model development is a design activity
- Civil 3D Design Workflow goal to develop construction ready surface models during the design process

Requirements of the Design Workflow

- Must produce surface models with sufficient detail to support AMG operations
- Surface Model output must be synchronized with plan sheets

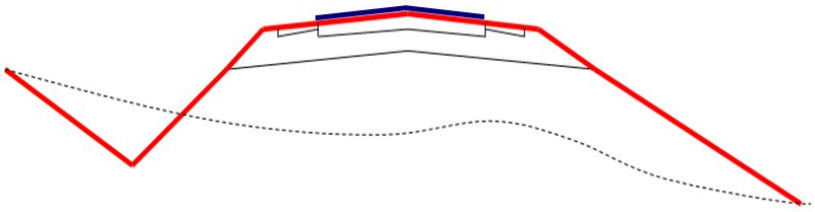
Surface Model Requirement

- WisDOT will implement a Surface Model Delivery Requirement starting in July 2014.
- Model content requirements and other details will be released summer of 2012.

Surface Model Content Concepts

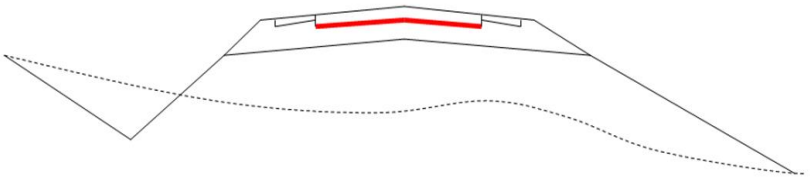
Roadway Model Surface - Top

Roadway Model Surface - Pavement



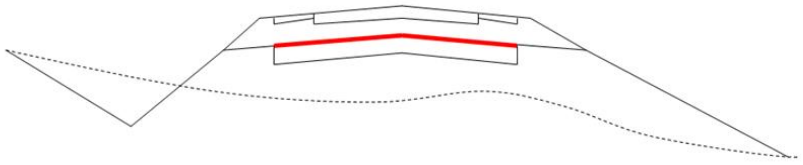
Surface Model Content Concepts

Roadway Model Surface - Base Course



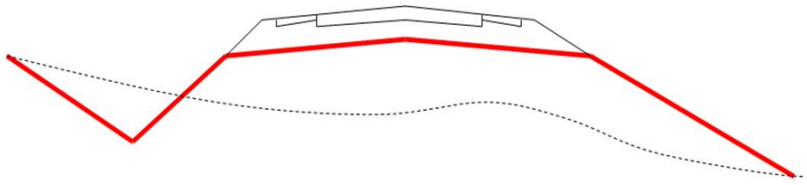
Surface Model Content Concepts

Roadway Model Surface – Select Crush



Surface Model Content Concepts

Roadway Model Surface - Datum



Surface Model Content Concepts

- Surfaces
  - Exist Top Finished Base Course Subbases Datum Pavement
- Surface model data density will be design speed dependent
- Surface models must be synchronized with plan sheets
- Additional content
  - Longitudinal breaklines
  - Horizontal alignments
  - Vertical alignments
  - Superelevation transition information
- Fully staged model requirement will be decided on project-by-project basis

Surface Model Gotta Knows

- What to model (Which surfaces, what features)
  - Everything in the 2D plan set plus features that aid design or construction
- How detailed to model (frequency)
  - Meet the construction specification
- Design software and workflows needs
  - Support model and plan sync and be efficient
- 3D models are a new product (not cross sections plus)
  - Transition, paradigm shift in construction and design

Roadway Model Evolution

- Ability to increase information included with the 3D Model will grow
- Methods of accessing information will become easier
- WisDOT looking to expand use of Roadway Models in:
  - Design
  - Construction
  - Integration with GIS
  - Operations
  - Maintenance
  - Planning
- Near future goals - Pipe networks, Quantity Takeoff, Integration with other design functions

Model Sharing Pilots 2011

- Determine Benefits of Providing 3D Roadway Models at Pre-Bid.
- Determine Utility of 3D Models for Bid Preparation.
- Establish Requirements for “Construction –Ready” 3D Models Flowing from Design Process.
  - Includes Model Content and Format.
- Field Test “Construction Readiness” of 3D Models.
- Identify and Implement any Changes to Design Workflows Necessary for Achievement of “Construction Readiness” in 3D Models.

Civil Integrated Management
3-D Modeling from a Program's Perspective
Contractor Input

Chris Goss
Hoffman Construction Company
06/15/2012

Use of 3-D Models

- Pre-Bid

(Goal - How can I reduce the cost of my bid so I can be the low bid?)

  - Cost to create the model for construction
    - This price can range from $2,000 to $15,000 depending on size of project and usefulness of data provided.
  - Looking for borrow excavation areas
  - Volume of non-structural areas

Use of 3-D Models (cont'd)
The Goal after Award

Use of 3-D Models (cont'd)

- Post-Award
  - The hand-off of data files from DOT to Contractor affects operations. Grading is usually one of the first items performed on a project, so the availability of data files helps get to the delivery date. Sending out pieces of the model leads to multiple updates and a chance for errors in each creation and transmission.
  - The processing of the files takes some time. It can be a week, or it can be over a month.
    - What format of data files are there available? Can I use them?
    - Import them into design software.
    - Review and adjust to match the paper plans.
    - Check final model against plans
    - Export to files that the equipment and rovers can use.

Model Data Types

- Text Format
  - Station, Offset, Elevation, (Description?)
  - Caice Slope Stake Report (*.ssk)
  - Pros
    - Simple data that can be understood by many parties (exporter and importer)
    - Can be used as a cut sheet to get the grading foreman on his way
    - Easily imported since this file type has been around a quite a while
  - Cons
    - Usually, it does not have good descriptions or they are inconsistent. It requires a lot of work prior to import.
    - Often comes from older design programs where the data is not the same as the cad-manipulated drawings
    - No forced break lines or TIN. Leaves room for interpretation in model

Model Data Types (cont'd.)

- Digital Design Files
  - *.xml,*.dwg, and *.dgn (thumbs up!)
    - 3-D model with Linework, please
  - Pros
    - TIME, TIME, TIME - Imports quickly. You are reviewing the model early in the process and are checking rather than recreating. Exporting to equipment earlier in the schedule.
    - The intent of the drainage is in the model, less interpretation
    - TINs for models.
    - Linework layers for the features
  - Cons
    - Reluctance of individuals to provide the data, usually due to lack of training on how to export the correct data. Time can be wasted here until the data is finally released.
    - Files can be a mess to sort through if the design files were not maintained well. Spaghetti comes to mind.
    - File versions for import can be a hurdle with all the software companies.

USH 10 Pilot Project

- This was a pilot project for WisDOT and Hoffman to review the hand-off and use of digital data files on a rural, four-lane grading project.
- The first set of files required a lot of reducing and adding of features. It was a struggle with which to work and review.
- WisDOT and Hoffman met and did some trading of sample files to see what would work better.
  - TIN data is great for the grades, but it doesn't do much for the visual orientation for the equipment operator or grade staker.
  - How can linework showing the planimetric features be exported? This will help the equipment operator stay oriented on the grade.
  - A new export file was created that had 3-D linework with point data incorporated. This is what the Hoffman designer was desiring, "The new data made the process from import, through reduction, and to export into the equipment and rover files extremely efficient!"

Closing Remark and Questions

- Hoffman has been involved in the process of developing the gps grading specifications and multiple pilot projects involving the grading and exchange of data files. WisDOT's and Hoffman's commitment to work together to come to a good solution has been very important to the program's success. All individuals involved understood that this is the route the industry has headed and its time we take advantage of the savings the technology can bring to the state. Pick a great team that can make it happen.

Civil Integrated Management
3-D Modeling from a Program's Perspective
Expanded Uses

Roberta Oldenburg
Mortenson Construction
06/15/2012

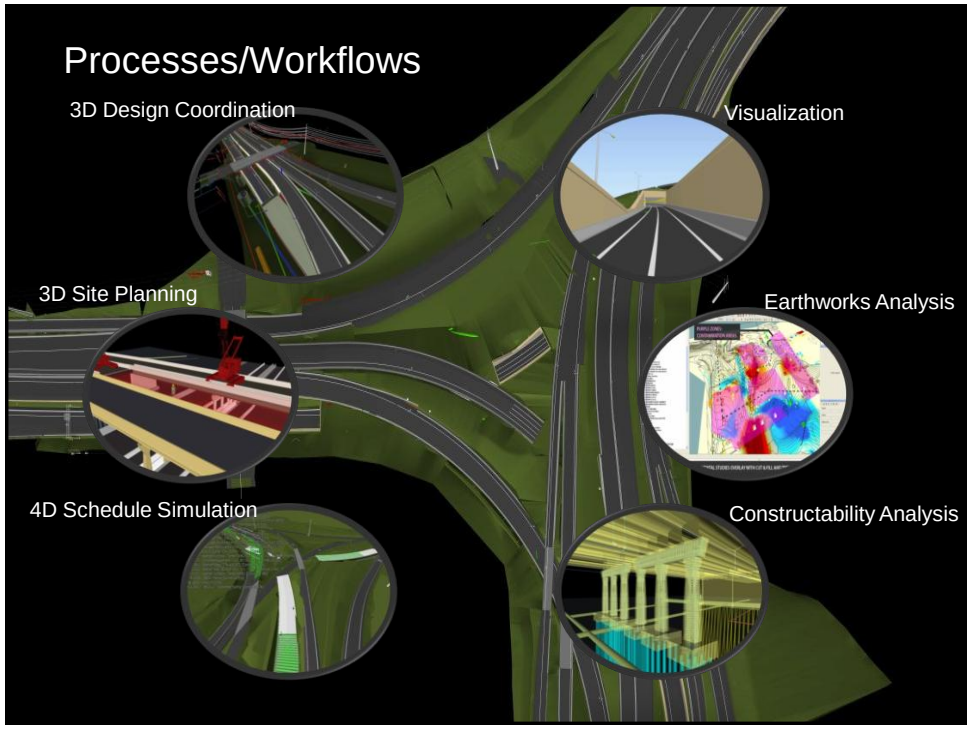
Expanded use of CIM at Wisconsin DOT

- Expanded uses
- Processes/Workflows
- Benefits/Deliverables
- Case Study
  - Tools
  - 3D Model
- Best Practices

Expanded Uses

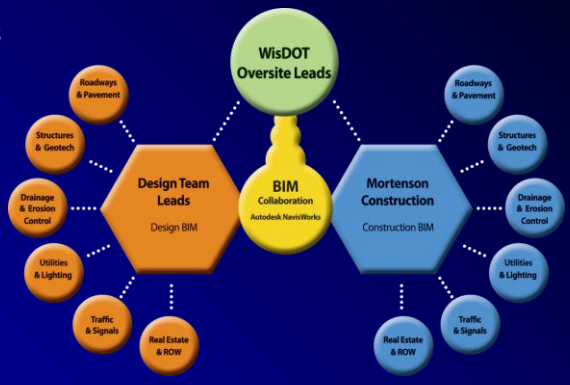
- Survey Control - LiDAR Mobile/Static
- Integrated survey – GPS/TS
- 3D Existing Model
- 3D Design Model
- Coordination
- 4D Model
- AMG
- As-Built/ Construction Model
- Operation and Maintenance Model

Processes/Workflows



Collaborative Process

- Owner - WisDOT
- Designers/ Consultants
- General Contractor & Subcontractors



CIM Process: Implementation

- Develop a Plan
- Identify Expectations
- Determine Deliverables
- Assign Responsibilities
- Determine appropriate LOD (level of detail)
- Understand the software and the compatibility issues
- Get all stakeholders involved
- Collaborate, Collaborate, Collaborate!

Benefits/deliverables of CIM

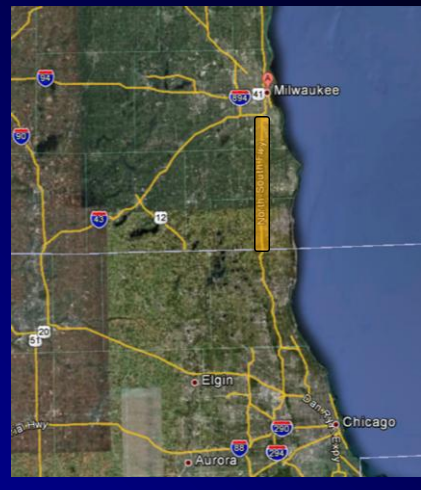
- Visualization of construction plans
- Improved communication with Stakeholders
- Improved QA/QC and estimating
- Model in addition to PS&E documents
- Improved safety and efficiency
- Streamlines schedule and budget

Case Study

I-94 N-S Freeway Project

- $1.9 b reconstruction and capacity expansion involving 35 miles

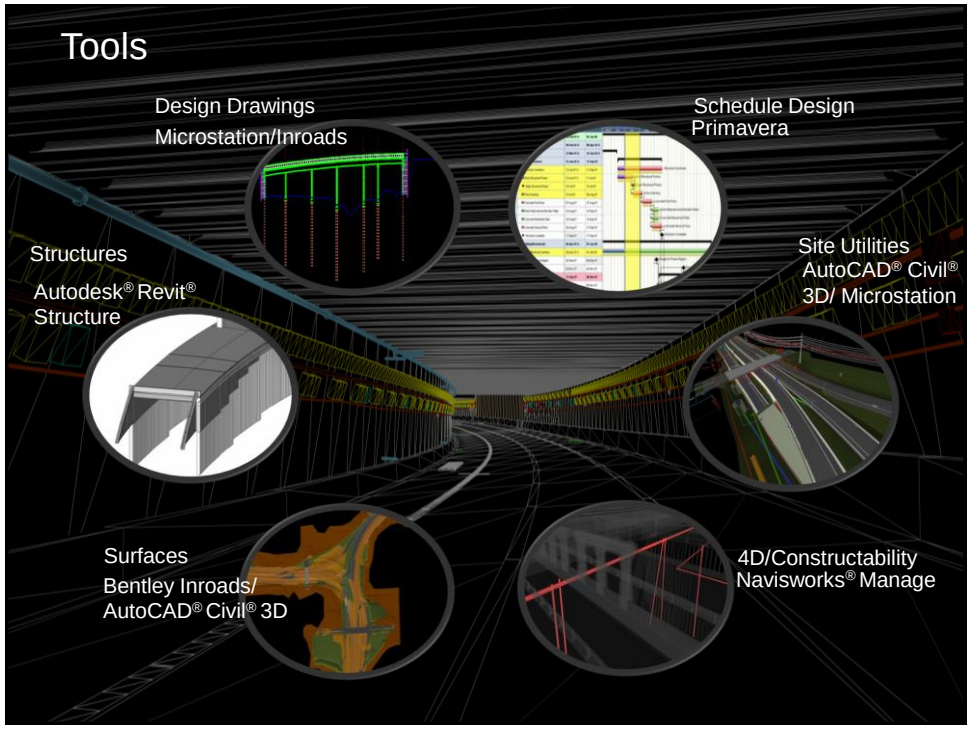
- Reconstruction of interchanges
  - Mitchell Interchange (I-94/I-894/I-43)
  - Airport system interchange
  - 17 additional service interchanges



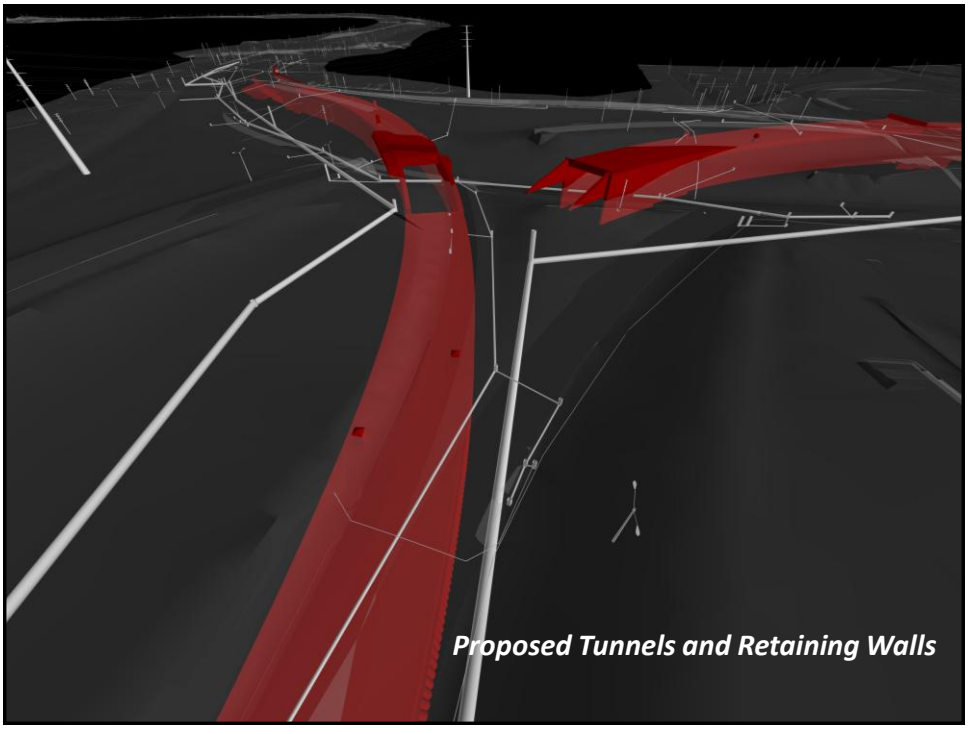
Proof of Concept: Mitchell Interchange Project

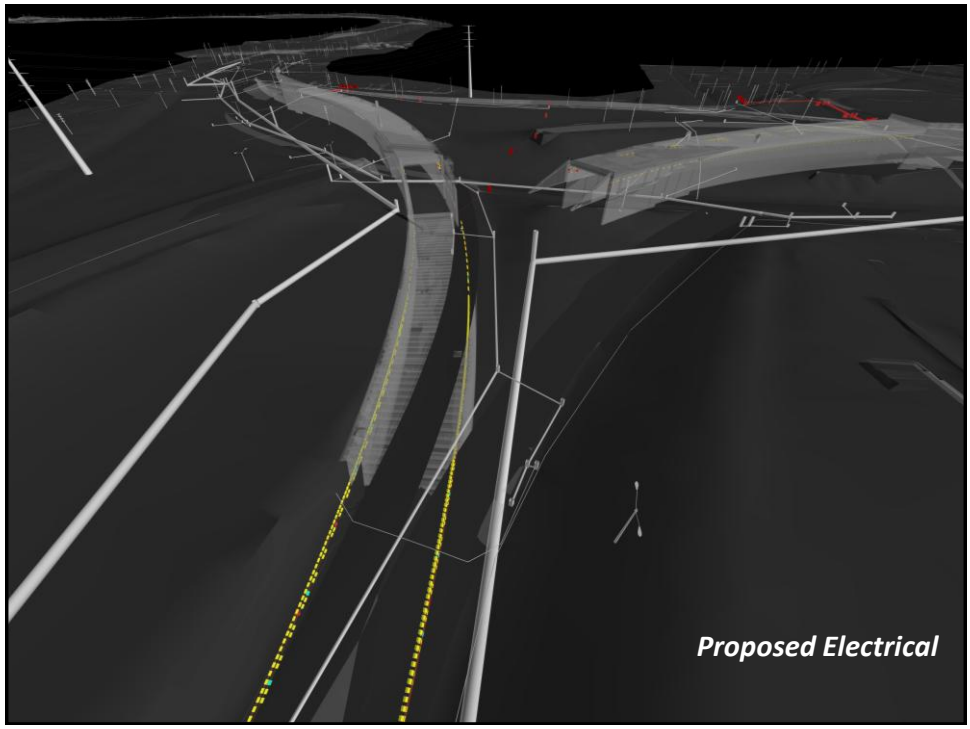
- $162.5 million Mitchell Interchange
- Handles over 195,000 avg. vehicles per day
- Project involves tunnels, bridges, system/service interchanges, ramps, retaining walls, noise walls, sign bridges, and utilities
- Temporary roads accommodate existing traffic during construction

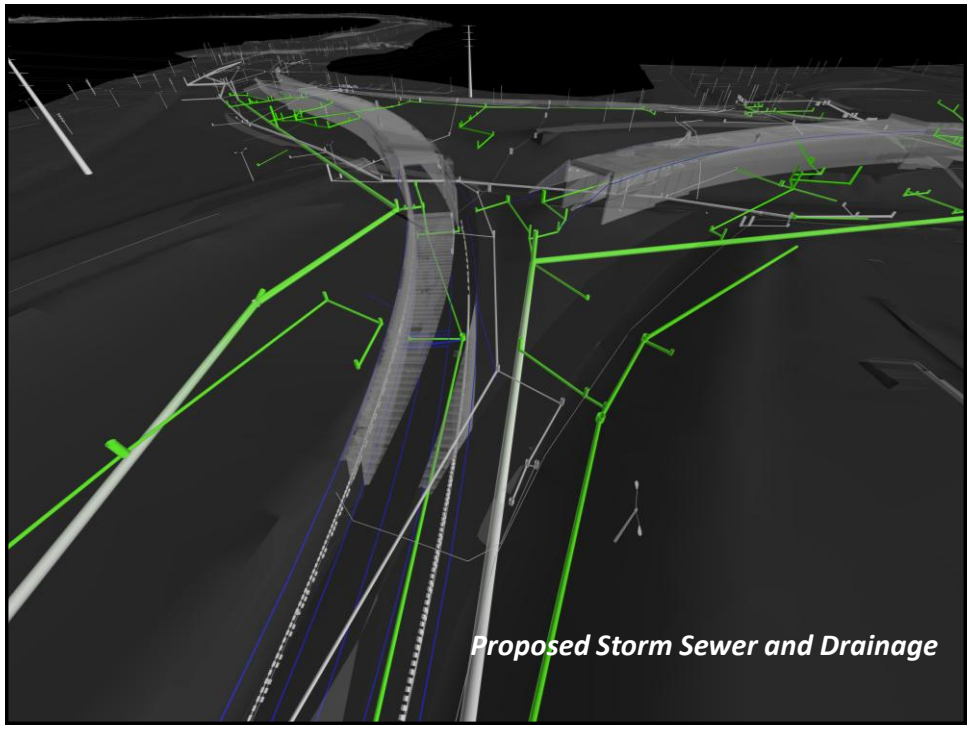
Tools

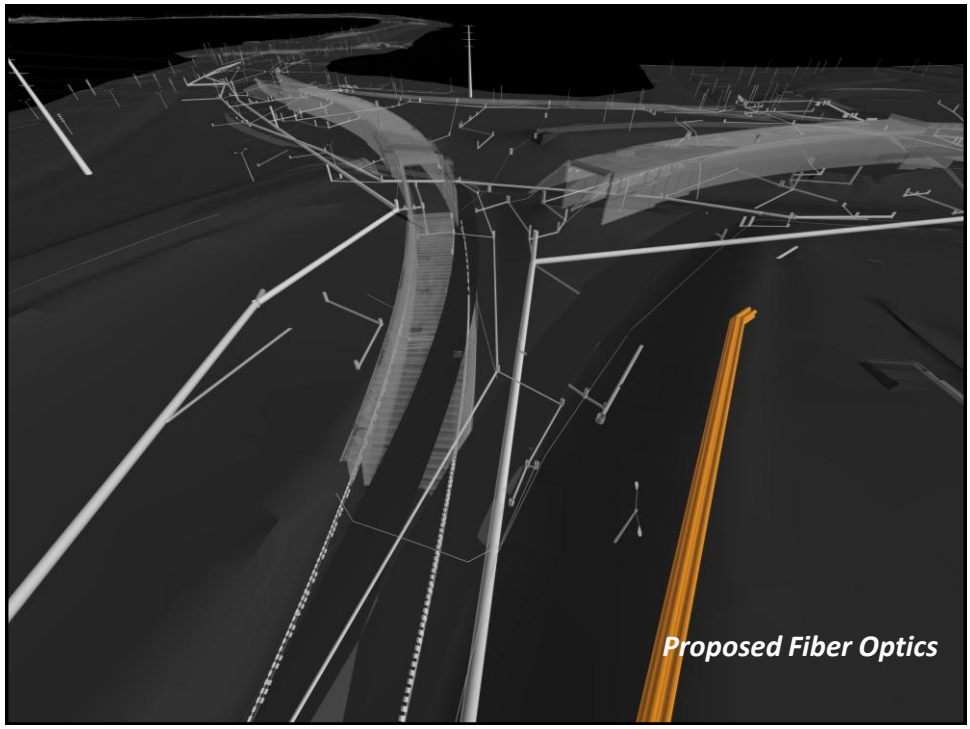


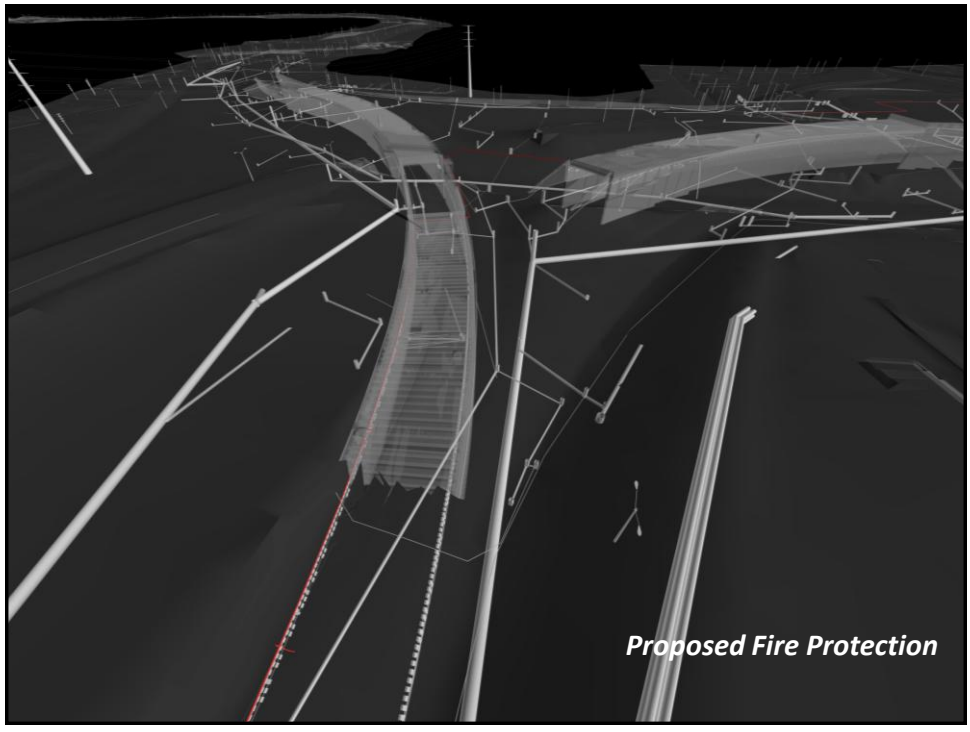

Existing Roadways, Utilities & Structures

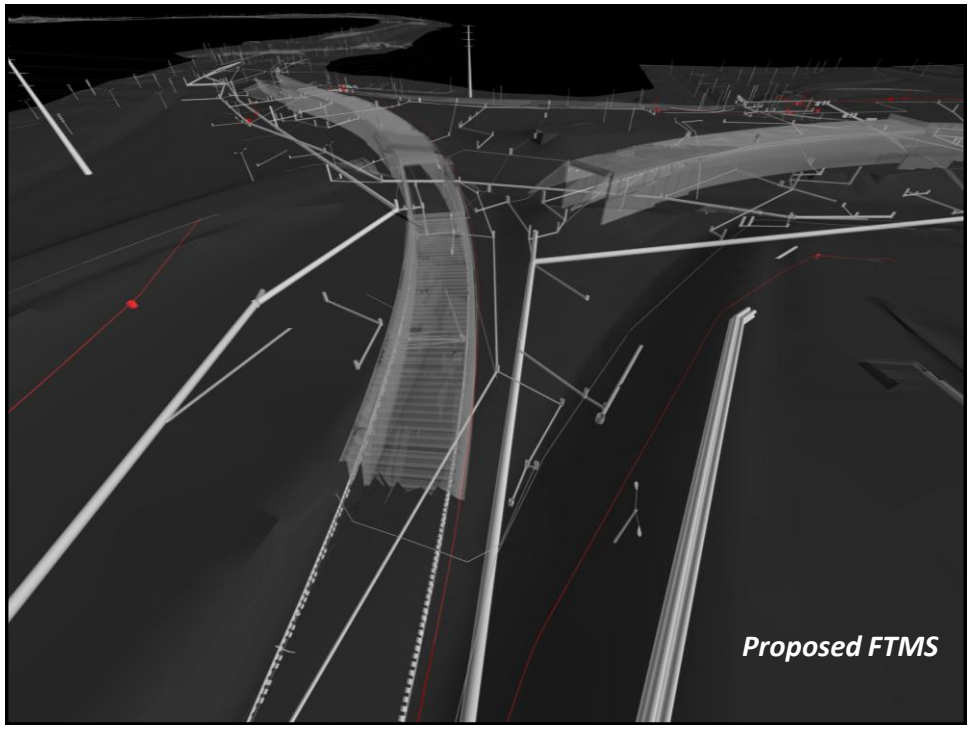

Proposed Tunnels and Retaining Walls

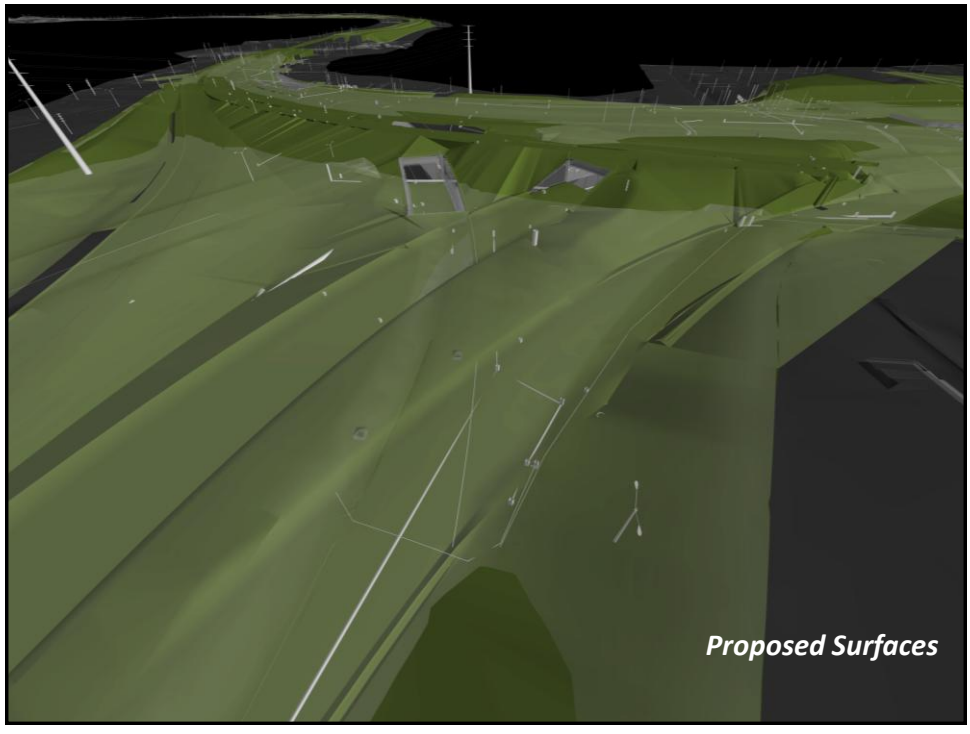

Proposed Electrical

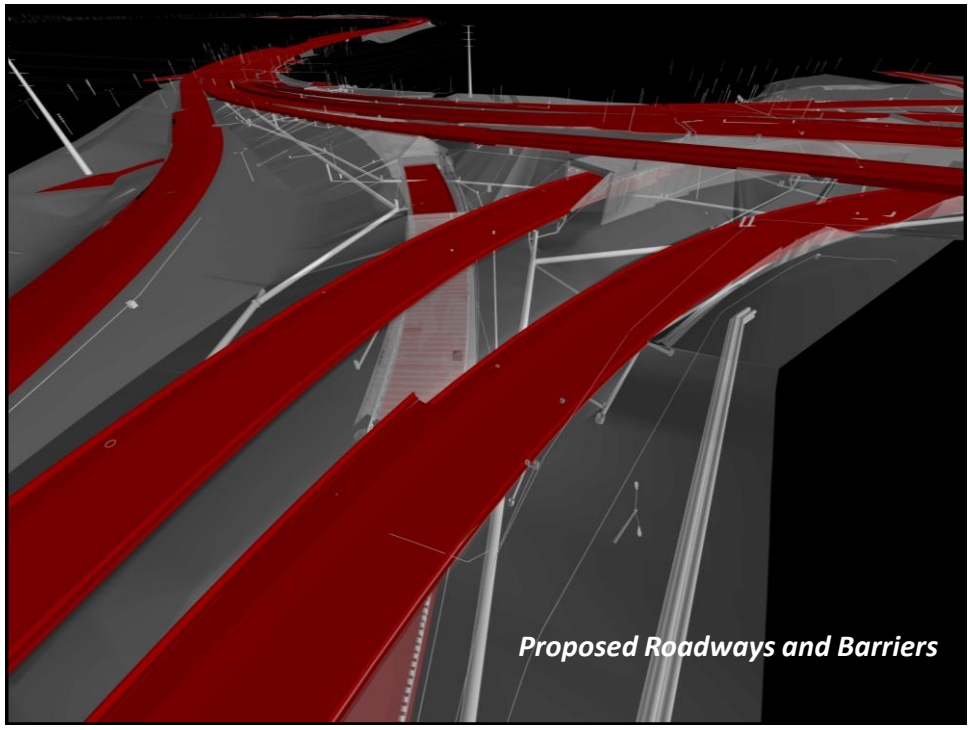

Proposed Storm Sewer and Drainage

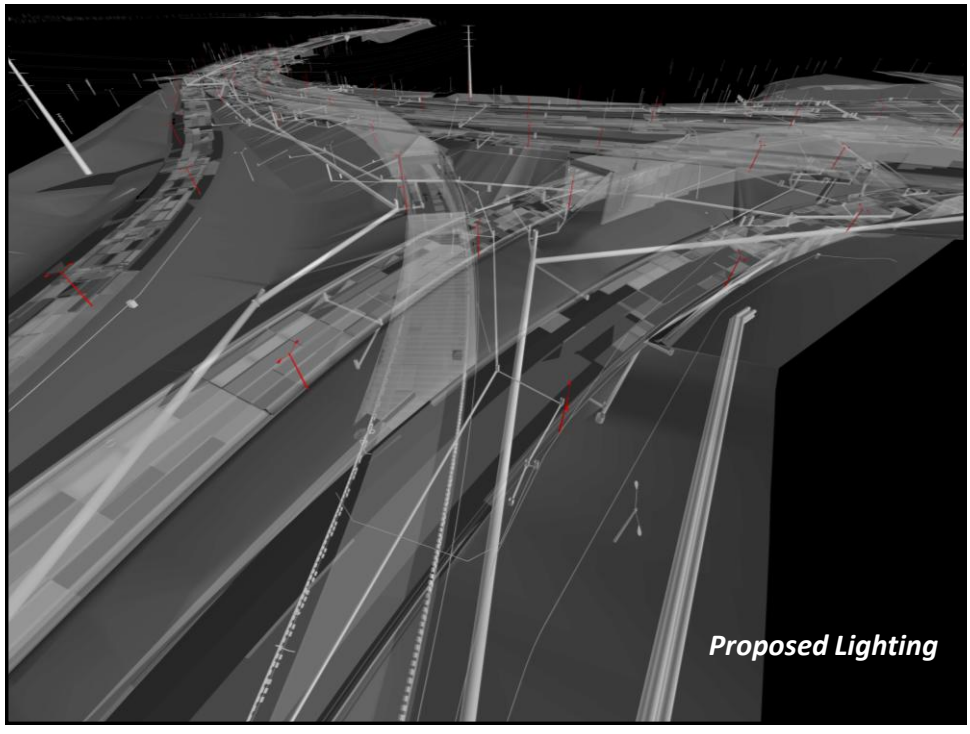

Proposed Fiber Optics

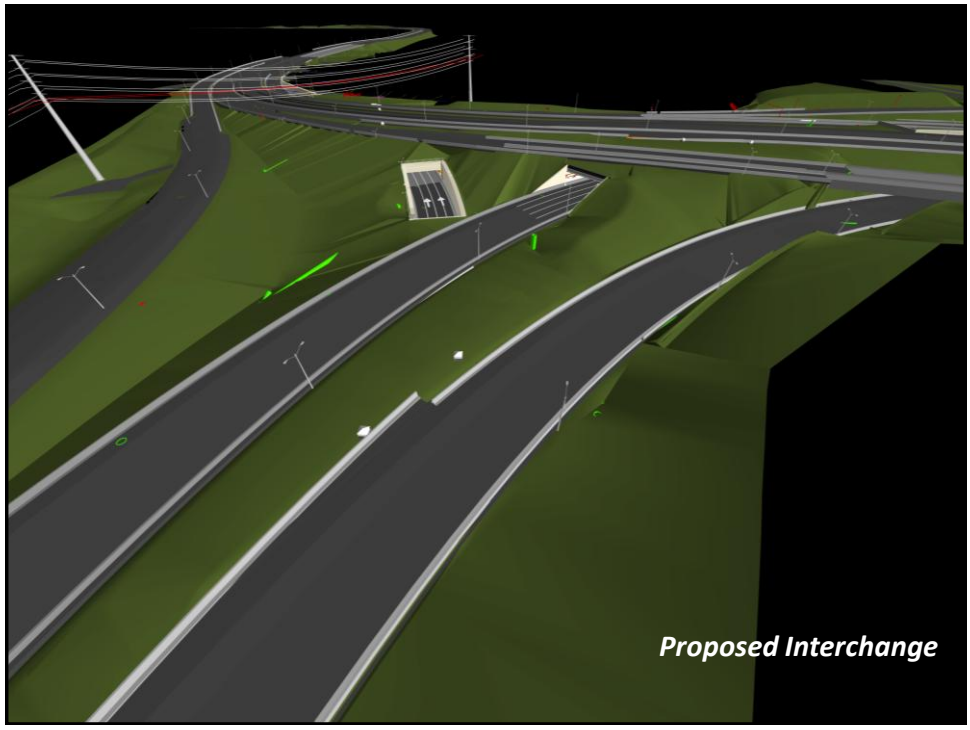

Proposed Fire Protection


Proposed FTMS


Proposed Surfaces


Proposed Roadways and Barriers


Proposed Lighting



What happens when you take a **4,572**-page design set and transform it into a 3D Model….

……and add **2,677** schedule tasks

Best Practices

- Need streamlined integrated collaborative 3D modeling sw tools to build representative 3D models
- Need continued intelligence involving digital data exchange to share 3D models
- Need compatible sw formats if multiple sw platforms are required and used
- Use robust hw/sw in field to make use of the 3D design models in construction

Best Practices

- Find the best available areas of value (i.e. ROI) to use 3D models in Construction (e.g. AMG-earthworks, complexity in construction, etc.)
- Use 4D scheduling tied to 3D modeling in the most complex portions of the construction to enable visualization and improved coordination
- Don't reverse engineer 2D design plans to 3D construction models; start Design with 3D models
- Provide 3D models from Designer to Contractor to yield lower bids, reduce rework, reduce risk by more readily identifying areas of concern, reduce duplication of services, improve workflows, and increase coordination

Q&A